Enguang Fan

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Education

University of Illinois, Urbana-Champaign, Urbana, USA 2022 – 2024

*M*aster of Computer Science

University of Illinois, Urbana-Champaign, Urbana, USA 2019 – 2022

B.S. in Statistics & Computer Science, **The Highest Distinction**

Beijing Jiaotong University, Beijing, China 2017 – 2019

***Transferred** to UIUC*, majored in Telecommunication Engineering

Publications

[1] **Enguang Fan**, Anfeng Peng, Matthew Caesar, Jae H Kim, Josh Eckhardt, Greg Kimberly, Denis Osipychev. *"Towards Effective Swarm-Based GPS Spoofing Detection in Disadvantaged Platforms."* In *MILCOM 2023 - 2023 IEEE Military Communications Conference (MILCOM)*, Boston, USA, Oct 2023, pp. 7. [Link]

[2] Yifan Chen, **Enguang Fan**, Matthew Caesar. *"Distributed UAV Swarms Positioning Using Multi-Agent Reinforcement Learning"* To be submitted to IEEE International Conference on Distributed Computing Systems (ICDCS 2023)

Research Experience

Probablistic Programming Data Augmentation May 2020 – Feb 2021

- Led the creation and implementation of a cutting-edge system for transforming probabilistic programs. This involved devising algorithms that automatically modify program structures to enhance robustness against data variability and uncertainty.
- Pioneered the integration of advanced statistical methods within the system, enabling it to anticipate and adapt to diverse probabilistic scenarios, significantly improving the accuracy and reliability of program predictions.
- Conducted extensive robustness assessments of probabilistic programs using Stan and R. My involvement in benchmarking, simulation, and performance modeling contributed to breakthroughs in understanding program behavior and efficiency under varying conditions, setting new standards in the field.

ROS-based Swarm Drones SLAM May 2022 – July 2022

- Designed a custom ROS (*Robotic Operating System*) package for swarm drones simulation, enabling multi-drone communication and coordinated control via ROS-UDP.
- Developed a real-time UDP-based communication protocol, facilitating coordination and local mapping information sharing across drone swarm. Achieved a 50% message delivery speed improvement over ROS-native protocol.
- Implemented a Cooperative SLAM (Simultaneous Localization and Mapping) algorithm for multi-drone scenarios within Gazebo simulation environment.
- Integrated YOLOv4 into the SLAM system for real-time object recognition, segmentation, enhancing the capabilities of the custom ROS package.

Swarm-Based GPS Spoofing Detection by Multimodal Sensor Fusion May 2023 – Aug 2023

- Contributed to a research project focused on enhancing GPS spoofing detection in disadvantaged platforms, such as light weight drones in modern battlefields.
- The first paper in our knowledge to perform sensor fusion between motion data from IMU(Inertial-Measurement-Unit) and radio signal strength indicator.
- Proposed an EKF based architecture for sensor fusion, intelligently combining observations across multiple sensors to detect GPS spoofing and reconstruct coordinates with confidence levels.

- Utilized simulation studies based on real-world mobility and sensor traces to demonstrate that the proposed approach significantly improves location accuracy and lower the error variance compared to baseline techniques.

Deep-learning based Robotic Inertial Odometry Aug 2023 – Dec 2023

- Designed and Implemented two neural network architectures, LSTM and Transformer, in the context of inertial navigation. This involved integrating these architectures as unary factors into a state estimator based on factor graphs, showcasing their effectiveness in enhancing estimation accuracy in environments with limited visual features.
- Developed a novel approach to estimate IMU biases using deep learning techniques, significantly improving state estimation in visually challenging scenarios. This method is unique in its ability to infer IMU bias evolution, demonstrating a significant advancement in inertial measurement unit (IMU) bias modeling.
- Demonstrated the practical applicability of the proposed method through real-world experiments across various platforms, including quadruped robots, drones, and handheld devices. This highlighted the method's generalizability and robustness in different motion patterns

Multi-Frame Adversarial Attacks on SLAM Systems Aug 2023 – Present

- Developed and implemented an adversarial machine learning framework to attack on feature-matching based SLAM system, specifically the ORB-SLAM.
- Utilized Blender, a 3D computer graphics engine, to synthesize adversarial dataset, which involves rendering a static adversarial patch across multiple continuous frames.
- Demonstrated a marked increase in the susceptibility of visual odometry and SLAM systems to such adversarial patches. Both real-world and simulated evaluations revealed a significant 35% error escalation when subjected to these adversarial attacks

Teaching Experience

CS 341 System Programming

Graduate Teaching Assistant, Fall 2022

CS 437 Topics in Internet of Things

Graduate Teaching Assistant, Fall 2023

Honors

- IEEE MILCOM 2023 Student Travel Grant Winner [Link]
- UIUC Fall 2022 Teachers(TA) Ranked as Excellent by Their Students [Link]
- First Class Academic Scholarship at Beijing Jiaotong University (Top 3% in GPA)

Skills

- Programming: C/C++, Python, Matlab,
- Tools: PyTorch, Tensorflow, NumPy, OpenCV, ROS, CMake, Gazebo, PX4
- Techniques: Object-Oriented Design, Unit Testing, Machine/Deep Learning